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(54) Music and arithmetic teaching machine

(57) The appearance of the present invention simulates a telephone, but it includes a microprocessor so as to provide a music and arithmetic teaching machine with the functions of entertainment and education. Its object is to teach the basic musical notations, number-counting and the arithmetic operation of "addition", "subtraction", "multiplication" and "division" in an integrated and step-by-step progress. The main features of the present invention have are (1) that, during the course of learning a number, a speech synthesizer can speak the number, several digital displays D1 to D4 can display the numerical symbols, several displays P can simulate the fingers and palm of a hand to display the quantity concept, and all of them can jointly and clearly express the numerical concept to raise a child's learning interest and learning effect; (2) that, during the course of learning the musical notations, the speech synthesizer can speak a notation, a digital display can display a corresponding number to a random notation, a multisegment display can simulate the staff, and all of them can jointly express the concept of a musical notation.

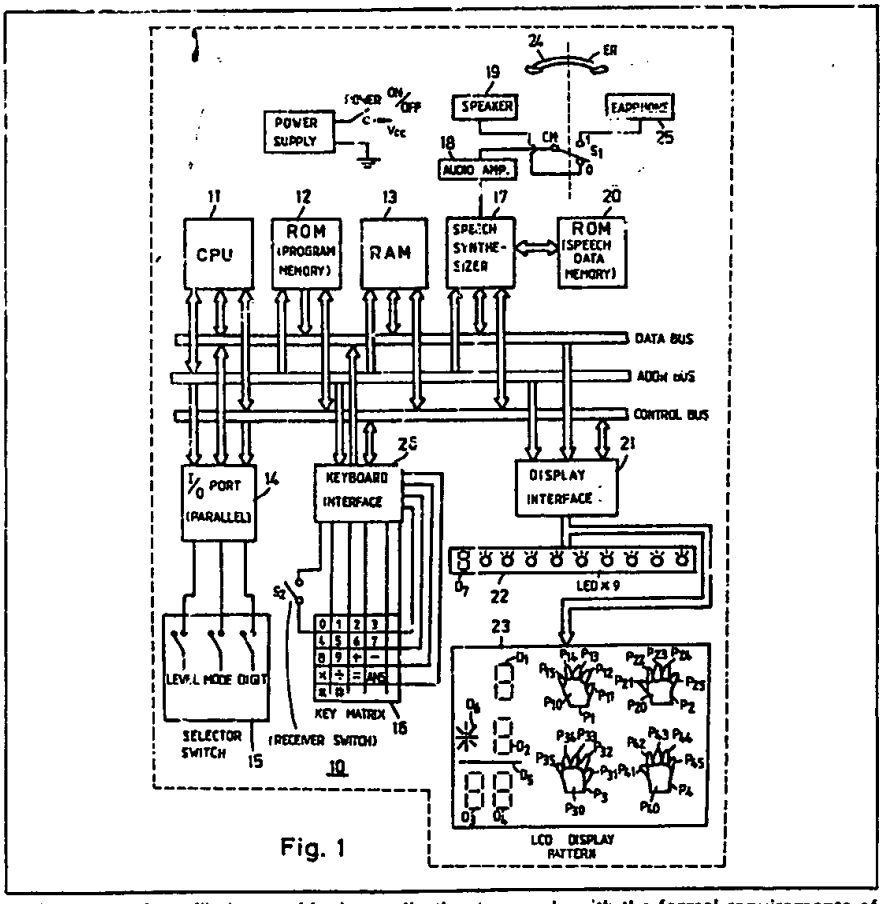

Fig. 1

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This print takes account of replacement documents later filed to enable the application to comply with the formal requirements of the Patents Rules 1978 or 1982.

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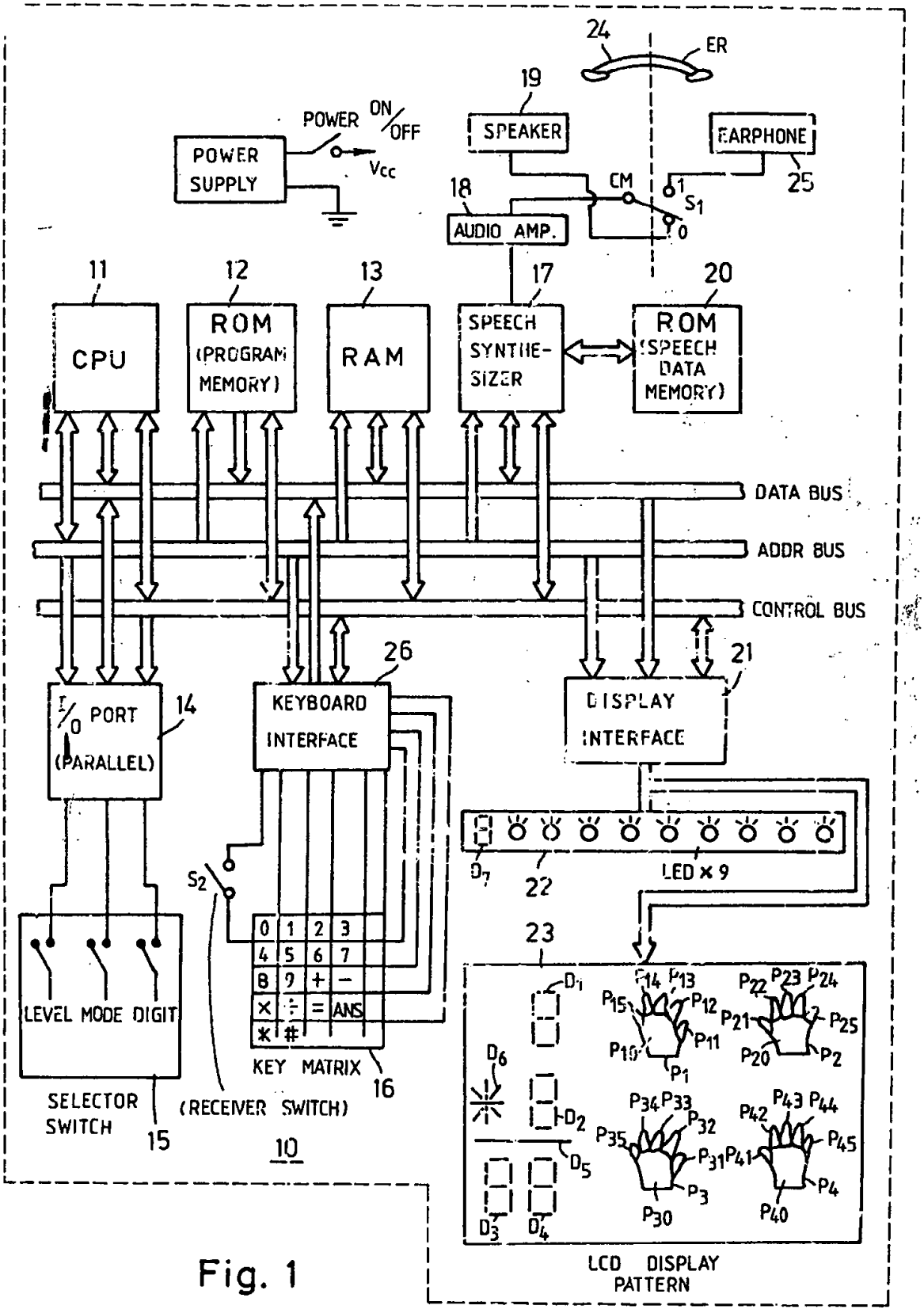

Fig. 1

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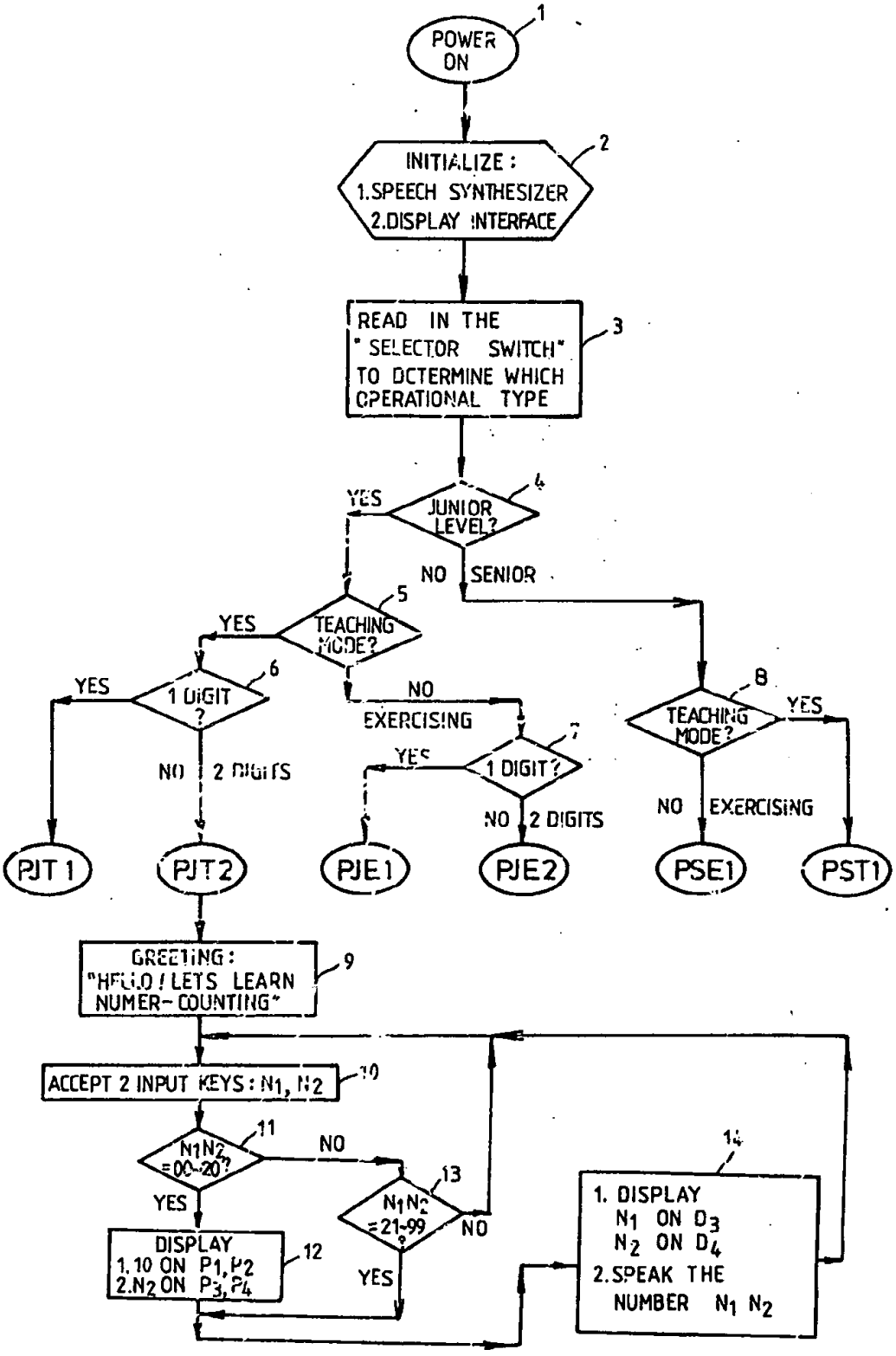

Fig. 2

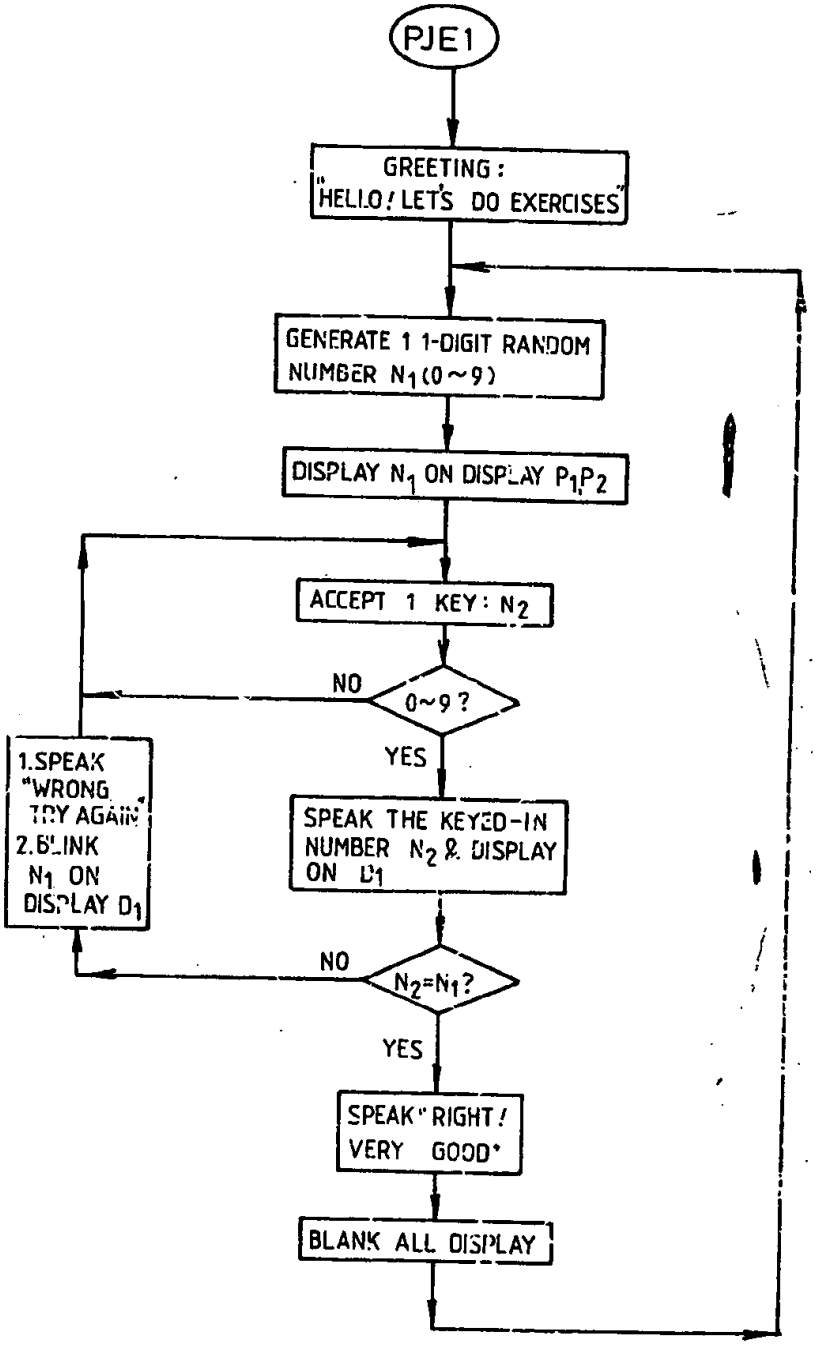
PJE1
GREETING:
"HELLO! LET'S DO EXERCISES"
GENERATE 1 1-DIGIT RANDOM NUMBER N_1 (0~9)
DISPLAY N_1 ON DISPLAY P_1P_2
ACCEPT 1 KEY: N_2
NO
0~9 ?
YES
1.SPEAK "WRONG TRY AGAIN"
2.BLINK N_1 ON DISPLAY D_1
SPEAK THE KEYED-IN NUMBER N_2 & DISPLAY ON D_1
NO
$N_2=N_1$?
YES
SPEAK "RIGHT! VERY GOOD"
BLANK ALL DISPLAY

Fig. 3

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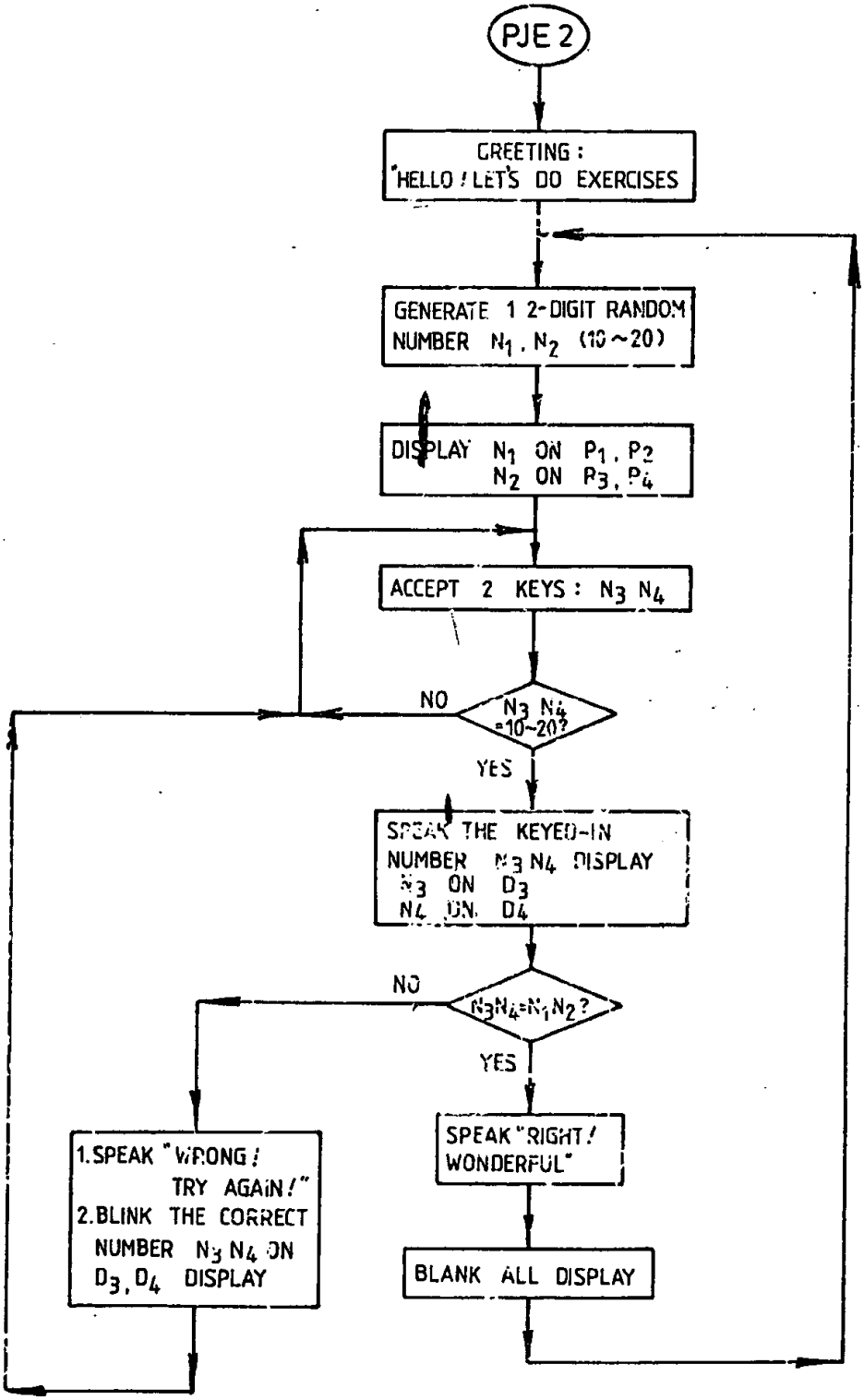

Fig. 4

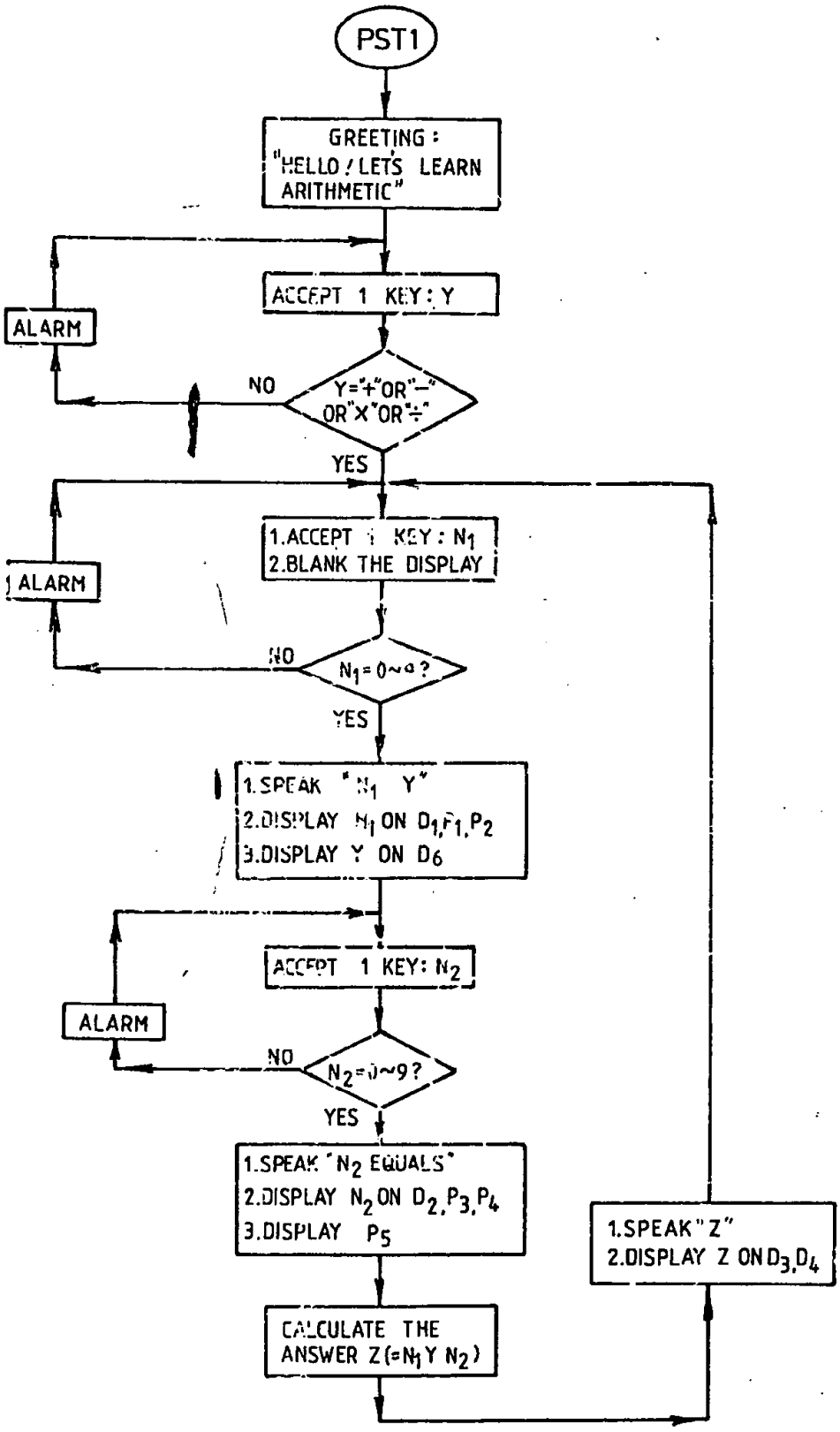
PST1
GREETING :
"HELLO ! LETS LEARN
ARITHMETIC"
ACCEPT 1 KEY : Y
ALARM
NO
Y="+"OR"−"
OR"X"OR"÷"
YES
1.ACCEPT 1 KEY : N1
2.BLANK THE DISPLAY
ALARM
NO
N1=0~9 ?
YES
1.SPEAK "N1 Y"
2.DISPLAY N1 ON D1,P1,P2
3.DISPLAY Y ON D6
ACCEPT 1 KEY: N2
ALARM
NO
N2=0~9?
YES
1.SPEAK "N2 EQUALS"
2.DISPLAY N2 ON D2,P3,P4
3.DISPLAY P5
CALCULATE THE
ANSWER Z(=N1 Y N2)
1.SPEAK "Z"
2.DISPLAY Z ON D3,D4

Fig. 5

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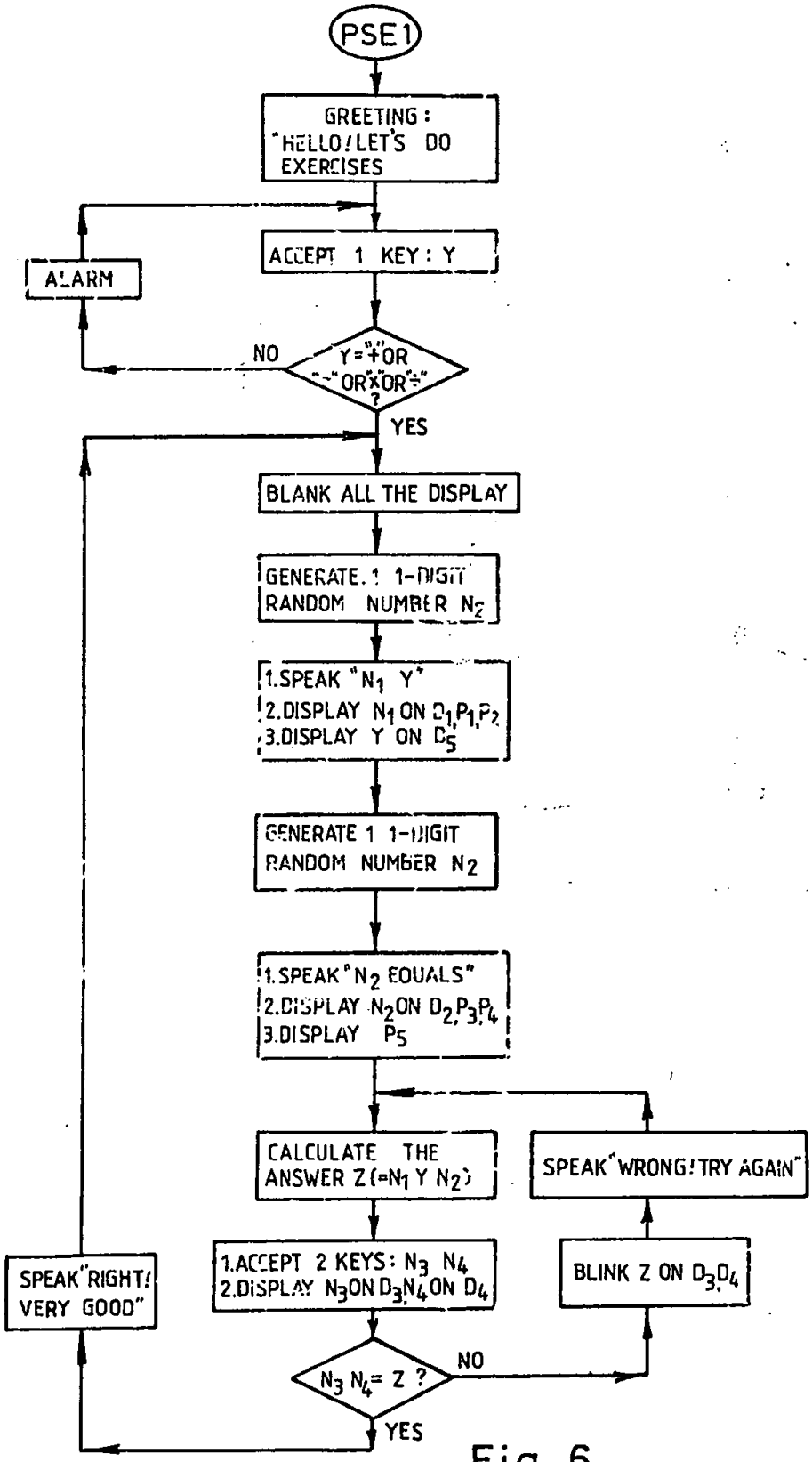

Fig. 6

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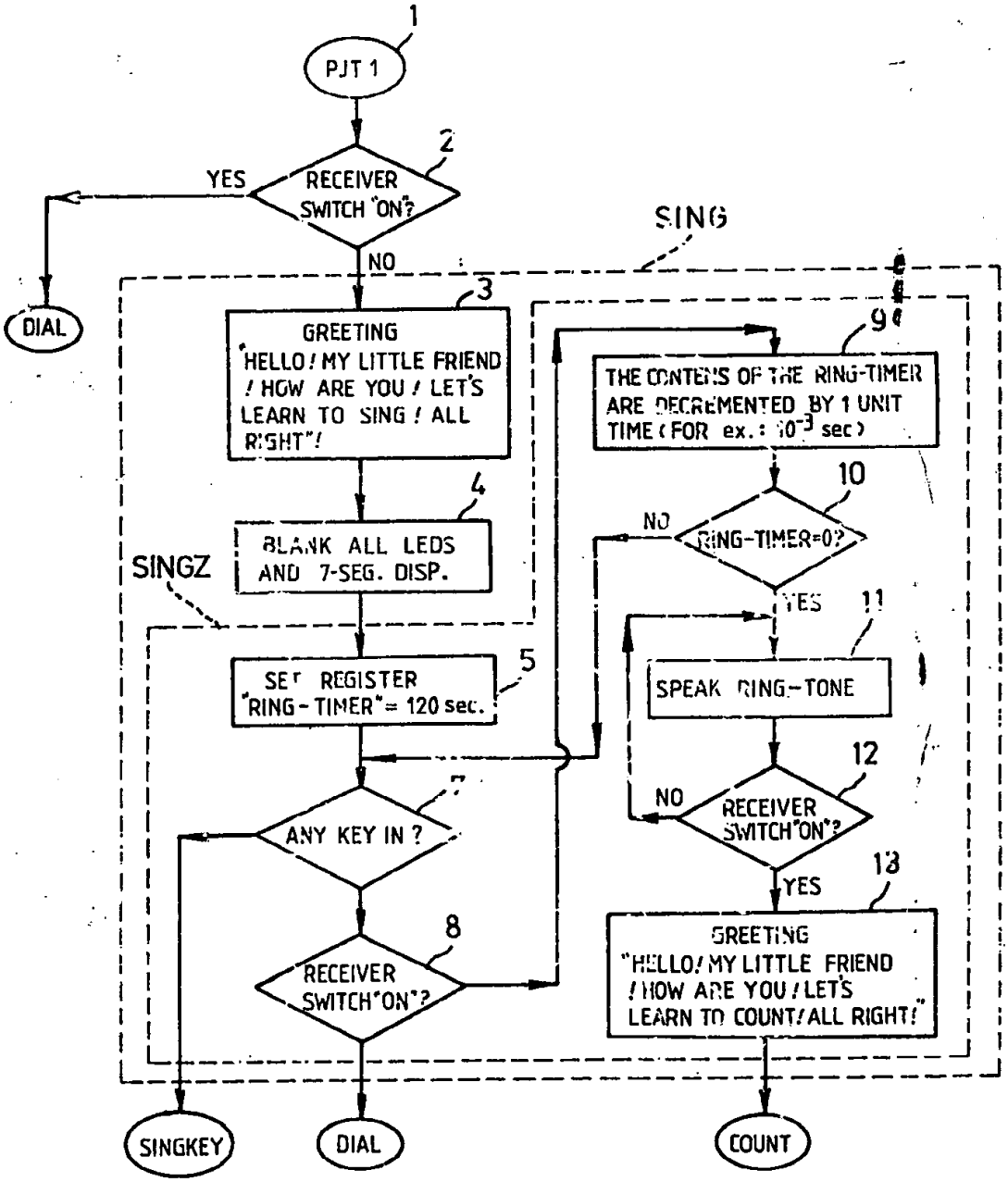

Fig. 7

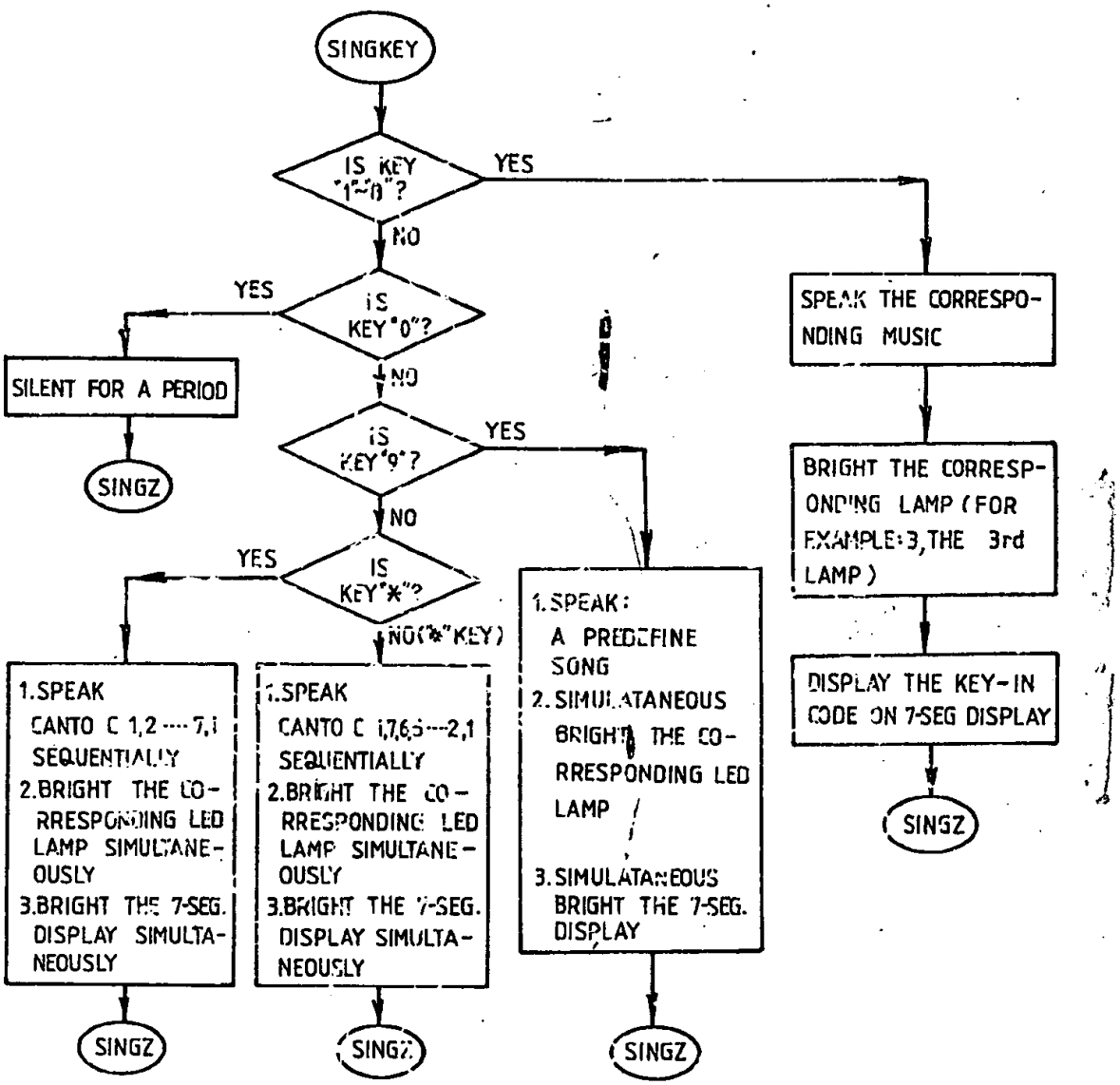
SINGKEY
IS KEY "1~8"?
YES
NO
SPEAK THE CORRESPONDING MUSIC
IS KEY "0"?
YES
NO
SILENT FOR A PERIOD
SINGZ
IS KEY "9"?
YES
NO
BRIGHT THE CORRESPONDING LAMP (FOR EXAMPLE: 3, THE 3rd LAMP)
IS KEY "*"?
YES
NO("*"KEY)
DISPLAY THE KEY-IN CODE ON 7-SEG DISPLAY
1. SPEAK A PREDEFINE SONG
2. SIMULATANEOUS BRIGHT THE CORRESPONDING LED LAMP
3. SIMULATANEOUS BRIGHT THE 7-SEG. DISPLAY
1. SPEAK CANTO C 1,2 ---- 7,1 SEQUENTIALLY
2. BRIGHT THE CORRESPONDING LED LAMP SIMULTANEOUSLY
3. BRIGHT THE 7-SEG. DISPLAY SIMULTANEOUSLY
1. SPEAK CANTO C 1,7,6,5 ---- 2,1 SEQUENTIALLY
2. BRIGHT THE CORRESPONDING LED LAMP SIMULTANEOUSLY
3. BRIGHT THE 7-SEG. DISPLAY SIMULTANEOUSLY
SINGZ
SINGZ
SINGZ
SINGZ

Fig. 8

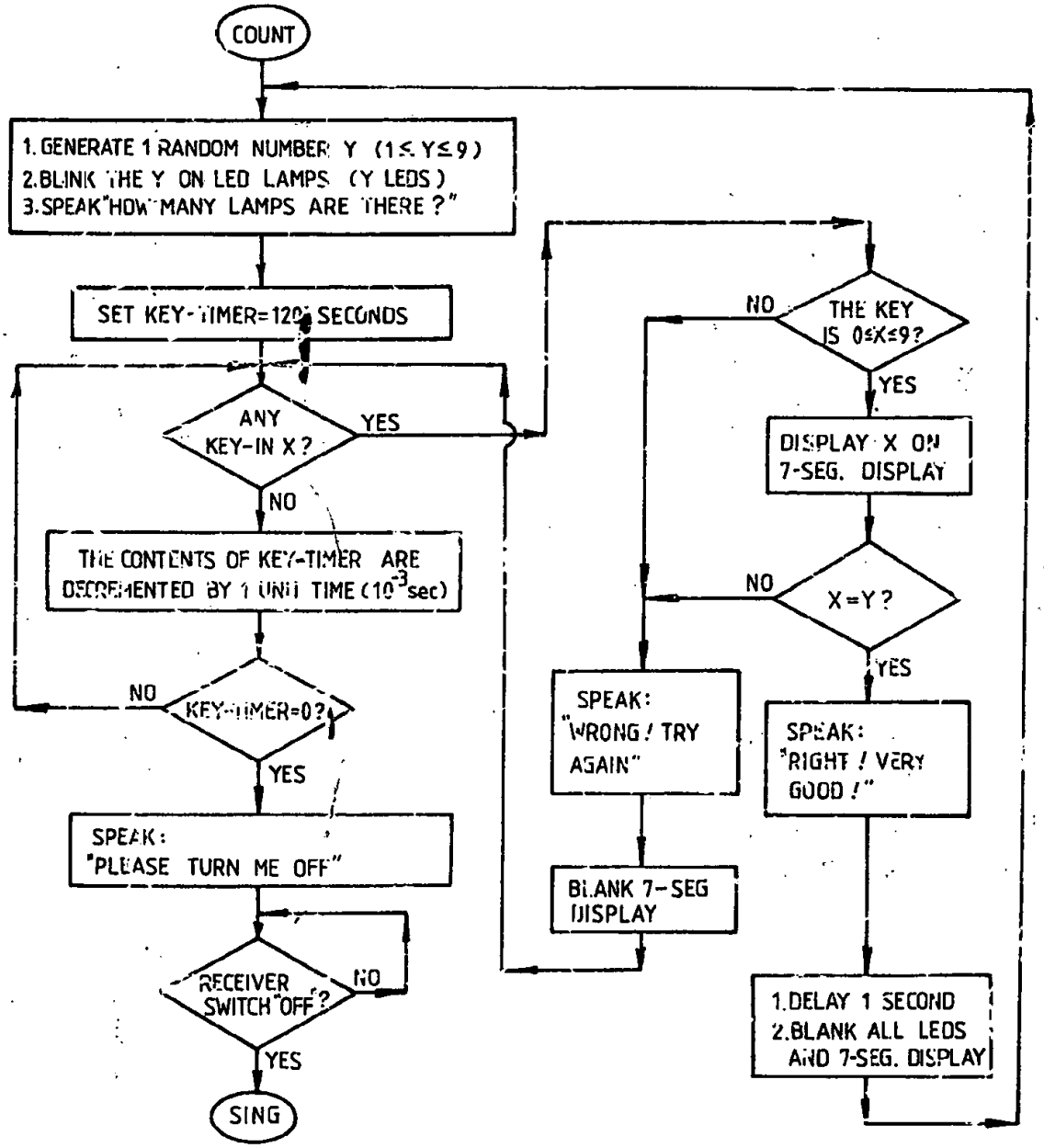
COUNT
1. GENERATE 1 RANDOM NUMBER Y (1≤Y≤9)
2. BLINK THE Y ON LED LAMPS (Y LEDS)
3. SPEAK "HOW MANY LAMPS ARE THERE ?"
SET KEY-TIMER=120 SECONDS
ANY KEY-IN X ?
YES
NO
THE CONTENTS OF KEY-TIMER ARE DECREMENTED BY 1 UNIT TIME (10^-3 sec)
NO
KEY-TIMER=0?
YES
SPEAK: "PLEASE TURN ME OFF"
RECEIVER SWITCH "OFF"?
NO
YES
SING
NO
THE KEY IS 0≤X≤9?
YES
DISPLAY X ON 7-SEG. DISPLAY
NO
X=Y ?
YES
SPEAK: "WRONG ! TRY AGAIN"
BLANK 7-SEG DISPLAY
SPEAK: "RIGHT ! VERY GOOD !"
1. DELAY 1 SECOND
2. BLANK ALL LEDS AND 7-SEG. DISPLAY

Fig. 9

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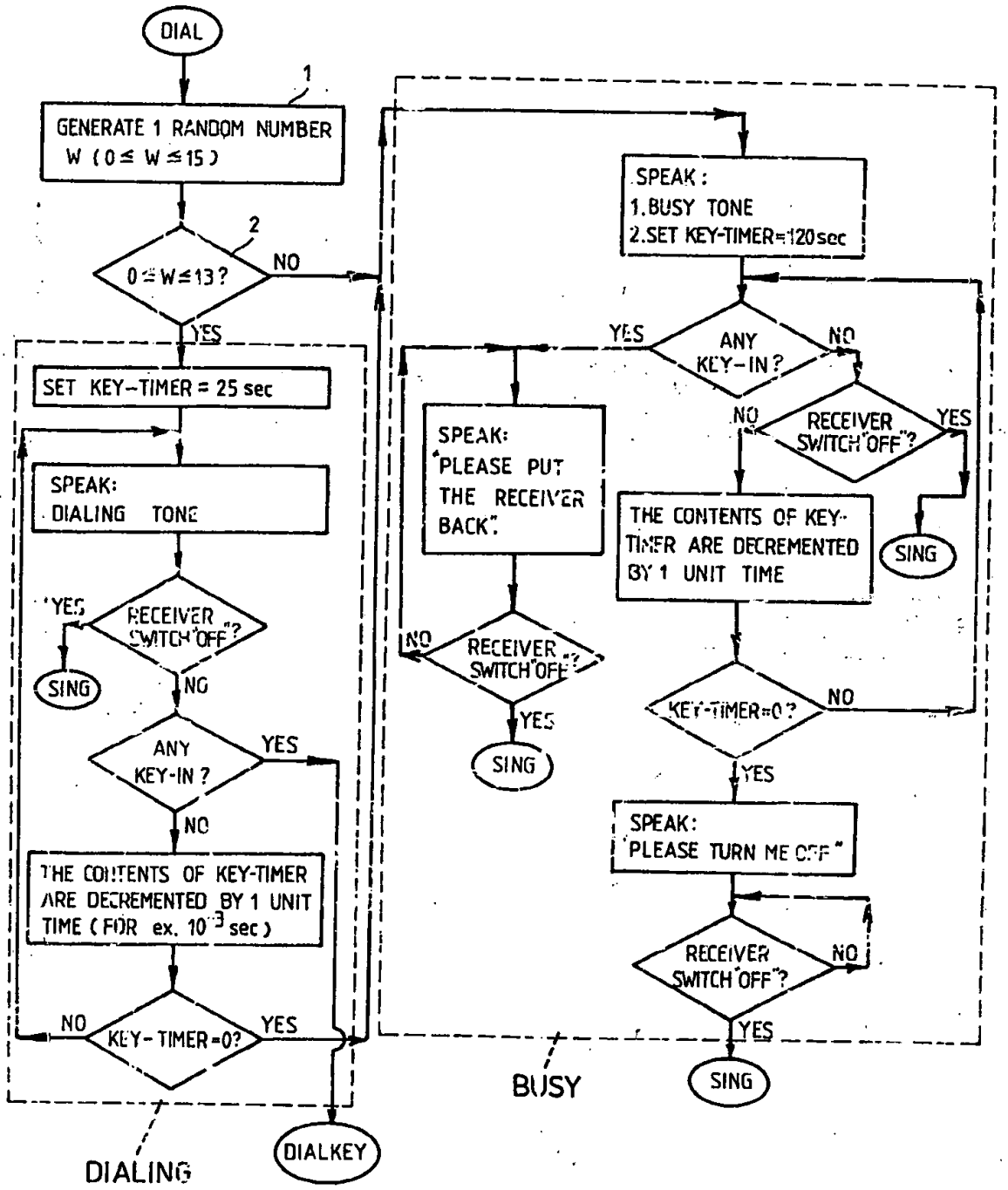

Fig. 10

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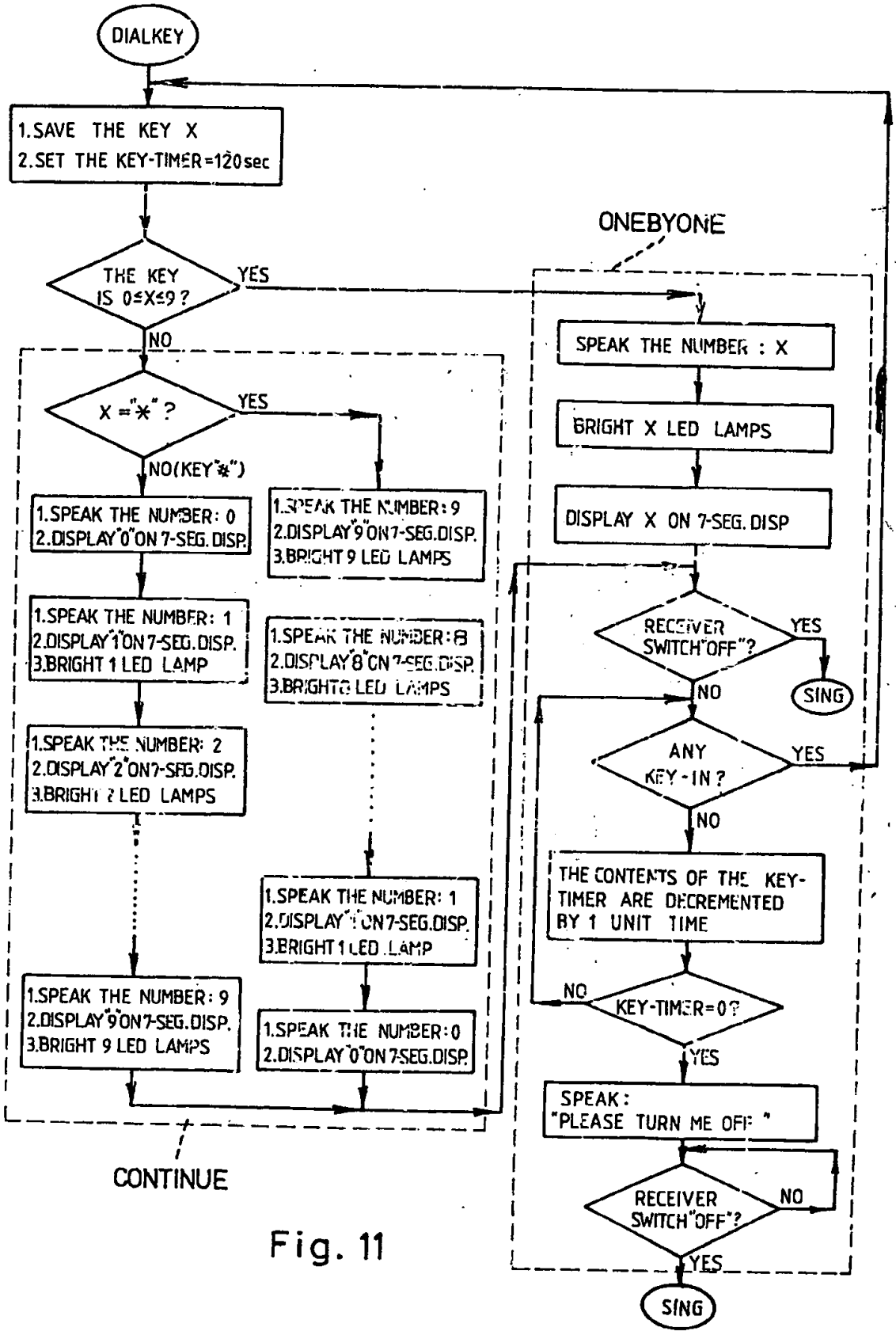

Fig. 11

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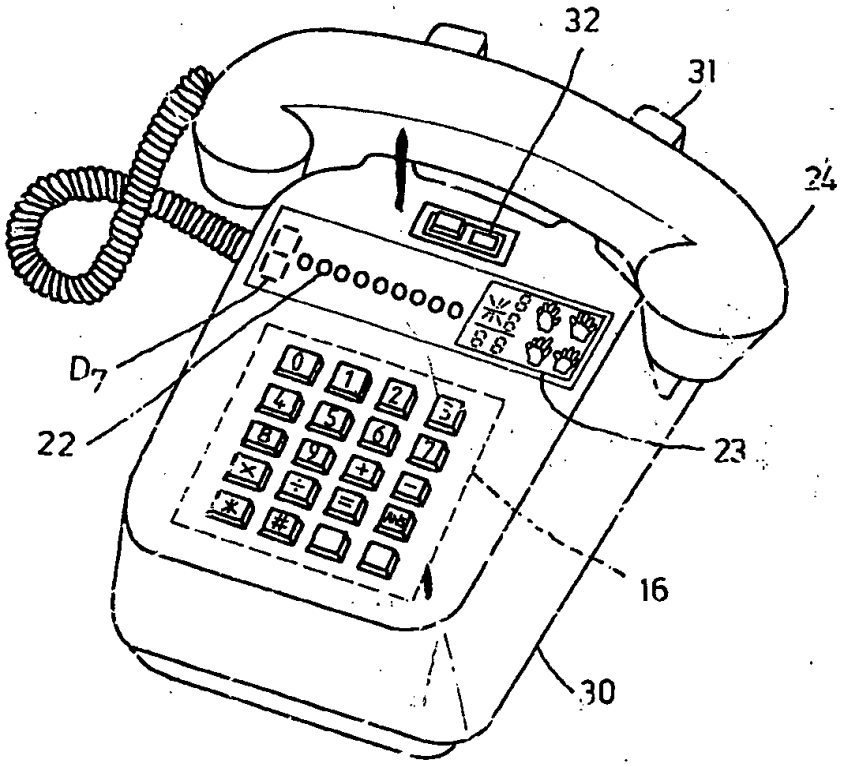

Fig. 12

SPECIFICATION

Music and arithmetic teaching machine

This invention relates to a teaching toy, particular to a teaching machine being able to speak and display patterns and numbers.

The toys for enlightening the child's wisdom are numerous in the market, of which some are even made by the electronic technology. But due to insufficient functions in design, they are unable to reach the integral teaching and step-by-step learning effects ranging from the number identification to the arithmetic operations.

The features of the present invention are that, in addition to the speaking function, biological or geometric patterns are used to express the quantity. For example, fingers are used to express the quantity and the staff expresses the musical scale. As a result, even a child of one year old can be educated from the identification of digits, musical notations, pronunciations, quantity gradually to the arithmetic operations "Addition, Subtraction, Multiplication and Division".

The functions and operation methods of the present invention are stated as follows:

1. FUNCTIONS: Used for children to learn how to identify the digits, the musical notations (Junior Level) and how to operate the digits (Senior Level), and the selection of Junior or Senior Level is made by a switch (or a key) (depending on the child's situation). During operation, a speaker could speak the digits or the musican notes (such as Do, Re, Me . . .) and the operating sings (+, −, ×, ÷); in addition, the pattern display and the 7-segment digital display could display the desired quantity, scale digits and scale signs to raise the child's learning interest.

OPERATIONS: As far as the arithmetic learning is concerned, it could be divided into two different operation modes "teaching mode" and "exercising mode" and both of them will be described as follows:

1. TEACHING MODE: The learner makes questions and the machine answers them. Except the operating signs and the quantity are displayed, the speaker also speaks them.

2. EXERCISING MODE: The machine makes questions on the display and the learner keys in the answers. When the keyed-in answer is correct the speaker would speak "Right" or it would speak "Wrong" if the answer is incorrect.

Nevertheless, if we select to learn "Junior Level" and "teaching mode", then it would become a Junior teaching mode. In this case, this machine would give the digit pronunciation, digit form, quantity concept and basic musical notations for the child's learning, so it is also called "Digit and signing teaching mode".

The present invention comprises:

I. A microproceassor control system comprising: a CPU; a ROM for storing the control program data; some RAMs for storing the realtime data when operating programs; a set of keyboard for communicating the learner with the CPU; and some I/O Ports for communicating the CPU with the outside.

II. A set of display device simulating vertical or horizontal arithmetic formats, which comprises several digital display for the operated number (such as the first addend), the operating number (such as the addend) and the answering number; a multisegment display for expressing the basic operating signs (+, −, ×, ÷); and a display for separating the answering number from the calculating numbers with one line for the vertical arithmetic format or with two lines for the horizontal arithmetic format.

III. Several pattern displays for expressing the quantity; for example, the display simulating our plam comprises two portions, one is simulating the fingers and another is simulating the plam center. When expressing a random number, the finger display would display the corresponding fingers, and when expressing zero, only the palm center is displayed.

IV. Several LEDs of which a corresponding number of lamps (or positions) are brighted under the situation of the junior teaching mode to represent the spoken number (or the scale), and a 7-segment display located in front of the said LEDs.

V. A speech synthesizer comprising a speech synthesizing circuit and an amplifier; its object is to correspondingly speak the displayed numbers, scale notes, operating signs and equal mark while the teaching machine is operated.

VI. Several selector switches for the operation selections, which comprise the selections of the learning degrees (junior or senior), the learning methods (teaching mode or exercising mode) and the learning digit (1-digit or 2-digit).

An embodiment of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:–

Figure 1 is a block schematic diagram of the system in accordance with the present invention.

Figure 2 is a flow chart of the main program in accordance with the present invention.

Figure 3 is a flow chart of the program block PJE1 of Fig. 2.

Figure 4 is a flow chart of the program block PJE2 of Fig. 2.

Figure 5 is a flow chart of the program block PST1 of Fig. 2.

Figure 6 is a flow chart of the program block PSE1 of Fig. 2.

Figure 7 is a flow chart of the program

block PJT1 of Fig. 2.

Figure 8 is a flow chart of SINGKEY ROUTINE of Fig. 7.

Figure 9 is a flow chart of COUNT ROUTINE of Fig. 7.

Figure 10 is a flow chart of DIAL ROUTINE of Fig. 7.

Figure 11 is a flow chart of DIALKEY ROUTINE of Fig. 10.

Figure 12 is the appearance of the present invention.

The under-mentioned is a feasible embodiment of the present invention, in which Fig. 1 is the hardware structure, Figs. 2–11 are the software flow chart, and Fig. 12 is the appearance of the present invention. Herewith, all of them will be described as follows:

I. The system 10 in Fig. 1 is the circuit block of the hardware structure which comprises a CPU 11, a ROM 12 for storing the control programs, some RAMs 13 for storing the real-time data during operating the programs, I/O Ports 14, three selector switches 15, a keyboard interface 26, a key matrix 16, a speech synthesizer 17, an audio amplifier 18, a speaker 19, some ROMs 20 for storing the phonic signal data of the speech synthesizer, a display interface 21, nine LEDs, a 7-segment display 22 located in front of the said LEDs, and a set of LCD display 23, all of them will be herewith described as follows:

1. The selector switch has three switches, the first is the LEVEL used to select the junior level (learning how to identify the numbers and the basic musical notations) or senior level (learning the arithmetic operations); the second is the MODE used to select the learning methods which are divided into two kinds "teaching mode" and "exercising mode": the third is the DIGIT used to select the "digit" for the numbers to be used during learning the calculations (which could be 1-digit or 2-digit).

2. The key matrix comprises digital keys 0–9, four basic operating sign keys "+", "−", "×", "÷", an equal mark key "=", and answer key "ANS", a "#" key (representing to count or sing upward from 0, such as 0, 1, 2, . . . 9), a "*" key (representing to count or sing downward from a high digit, such as 9, 8, 7, . . . 0).

3. The LCD display comprises the displays D1–D6 and the displays P1–P4, all of them are further described as follows:

(1) D1–D4 are the conventional 7-segment digital displays, in which D1, D2 are the operands, D3 and D4 are the answer.

(2) D5 is a 1-segment display used to separate the answer from the operands under the vertical arithmetic format.

(3) D6 is a 9-segment display used to display the operating sign and each sign is expressed by brighting a corresponding number of segments.

(4) P1–P4 are the displays used to simulate our fingers and palms, each has 6 segments of which five segments (P_{n1}–P_{n5}, n = 1,2,3,4) are simulating our fingers and the remaining one (PnO, n = 1,2,3,4) is simulating the palm.

4. 22 has nine LEDs and a 7-segment display, which is used only when the selector switches select the "junior teaching mode".

5. The switch S1 is used to connect the output of the speech synthesizer into the speaker or the receiver's earphone; S1 and S2 are coaxially controlled by the receiver.

II. Fig. 2 is the main software flow chart of the present invention, which is further described as follows:

1. The flow chart block 1 indicates the program's location when the power is on.

2. The flow chart blocks 2 and 3 are the overhead operations for initializing the programs, in which the block 2 is initializing the speech synthesizer and the display interface, and the block 3 is reading the I/O Port.

3. The block 4 is checking whether the switch "LEVEL" for the learning degrees is turned to the junior level, enter into the block 5 is YES, or enter into the block 8.

4. The block 5 is checking whether the switch "MODE" for the learning methods is turned to the teaching mode, enter into the block 6 is YES, or enter into the block 7 (exercising mode).

5. The work contents of the blocks 6 and 7 are the same, each is checking whether the switch "DIGIT" for the learning digits is turned to the 1-digit (if NO, it means 2-digit).

6. The program blocks PJT1, PJT2, PJE1 and PJE2 are described as follows:–

PJT1–Junior teaching mode, used to identify the numbers and the basic musical notations.

PJT2–Junior teaching mode, the number-counting is a 2-digit.

PJE1—Junior exercising mode, the number-counting is a 1-digit.

PJE2–Junior exercising mode, the number-counting is a 2-digit.

7. The work contents of the blocks 8 and 9 are the same, each is checking whether the switch "MODE" for the learning methods is turned to the teaching mode.

8. The blocks PSE1 and PST1 are described as follows:

PSE1–Senior, exercising mode, the operated number are 1-digit.

PST1–Senior, teaching mode, the operated number are 1-digit.

9. The works of the blocks 9–14 are processing PJT2.

10. The work contents of the block 9 are: Make the speech synthesizer speak "HELLO! LET's LEARN NUMBER-COUNTING".

11. The block 10 accepts the input keys and the keyed-in number is a 2-digit. The block 11 is checking whether the keyed-in number is between 00–20; if it is, process

the works of the block 13.

12. The works contents of the block 12 are: The number N1 at the first digit is displayed as 10 quantity on the palm displays P1 and P2; and N_2 is displayed on P3 and P4 (while displaying, the finger number represents the quantity).

13. The work contents of the block 13 are: Check whether the keyed-in number exceeds the 2-digit; if YES, the program would jump back to the input part of the block 10 to re-accept the input keys.

14. As the embodiment of the present invention only applies four palm displays with five fingers each, it makes a total of 20 fingers and there is no way to display if the input keys exceed 20; therefore, the program would not process the works of the block 12 if it enters into the block 13 (representing the keyed-in number exceeds 20).

15. The block 14 has two works, one is to display the keyed-in numbers on the digital displays D3 and D4, another is to correspondingly speak the numbers via the speech synthesizer. The work contents of PJT2 as above mentioned are still within the limits of learning the numerical concept and do not enter into the stage of learning the basic arithmetic operations. Nevertheless, how to design a programmable basic operation is very easy for a designer who is skillful to the technology of microprocessor, and we don't intend to discuss it here.

III. Fig. 3–6 are the work contents of the program blocks PJE1, PJE2, PST1 and PST1 respectively, which are self-explanatory and unnecesary to repeat again.

IV. Fig. 7 is described as follows:

(1) The area "SINGZ" surrounded with the dotted line is a ROUTINE which comprises the flow chart from the block 5 to the block 13. According to the statement in each block we understand their work contents are:

(a) If there is any key-in within 120 seconds, the program would immediately jump into another ROUTINE "SINGKEY" to start works; (b) if there is no key-in after 120 seconds, the program would speak a simulating ring tone (as shown from the block 7 to the block 11); (c) if picking up the receiver (the RECEIVER SWITCH is turned on) within 120 seconds, the program would immediately jump into another ROUTINE "DIAL". If the telephone speaks a ring tone after 120 seconds, and then pick up the receiver, the program would speak the phrase as stated in the block 13 and then jump into the "COUNT".

(2) The area "SING" surrounded with the dotted line comprises the flow chart blocks 3, 4 and "SINGZ".

(3) The flow chart block 2 is to observe whether the "RECEIVER SWITCH" is "ON", if yes, jump into the "DIAL", or jump into the "SING".

(4) As above mentioned, we easily understand that the program would jump into the "DIAL" to work if we first pick up the receiver to turn the switches S1 and S2 (i.e. the receiver switch) "ON" as shown in Fig. 1; otherwise, jump into the "SING".

Fig. 8 is a "SINGKEY" ROUTINE and according to the statement in the blocks, we know their work contents are:

(a) if the key is "1"–"8", speak the corresponding musical notation 1,2,3, . . . 7 and i, bright and corresponding LED lamp and display the key-in code on the 7-segment display, then jump back to the "SINGZ" as shown in Fig. 7; (b) if the key is "0", silent for a period, then jump back to the "SINGZ"; (c) if the key is "9", speak a predefined song prestored in the ROM and simultaneously bright the corresponding LED lamp and the 7-segment display (d) if the key is "#" or "*", speak the corresponding musical notation 1,2,3, . . . 7 and i sequentially or countersequentially, bright the corresponding LED lamp and the 7-segment display simultaneously.

Fig. 9 is a "COUNT" ROUTINE and according to the statement in the blocks, we know the work contents are: (a) generate a random number Y firstly and blink the Y on the LED lamps (Y LEDs), then speak "HOW MANY LAMPS ARE THERE"; (b) if there is no key-in after 120 seconds, speak "PLEASE TURN ME OFF" and the program would jump back to the "SING" ROUTINE when the child hands up the receiver to turn the "RECEIVER SWITCH" "OFF"; (c) if there is a keyed-in number "X" within 120 seconds and if X = Y, speak "RIGHT! VERY GOOD!", then delay a second and blank all LEDs and the 7-segment display; if $X \neq Y$, speak "WRONG! TRY AGAIN!" and blank the 7-segment display (still bright the LEDs) waiting for next key-in, if there is not any correct keyed-in number within 120 seconds, the result would be the same as the said (b).

VII. Fig. 10 is a "DIAL" ROUTINE which will be described as follows:

(1) According to the blocks 1 and 2 we know the program has a chance of 87.5 percent to enter into the "DIALING" area surrounded with the dotted line and a chance of 12–5 percent to enter into the "BUSY" area surrounded with the dotted line.

(2) The work contents of the ROUTINE "DIALING" are:

(a) speak the dialing tone and if there is any key-in within 25 seconds, the program would immediately jump into the "DIALKEY";

(b) if there is no key-in after 25 seconds, jump into the "BUSY";

(c) if the "RECEIVER SWITCH" is "OFF" within 25 seconds, the program would immediately jump into the "SING".

(3) The work contents of the ROUTINE "BUSY" are:

(a) speak the busy tone and if there is any key-in within 120 seconds, speak "PLEASE PUT THE RECEIVER BACK", and the program would jump into the "SING" if the "RECEIVER SWITCH" is "OFF" at this time; (b) is there is no key-in after 120 seconds, speak "PLEASE TURN ME OFF" and the program would jump into the "SING" if the "RECEIVER SWITCH" is "OFF" at this time; (c) at any time the "RECEIVER SWITCH" is "OFF", the program would immediately jump into the "SING".

VIII. Fig. 11 is a "DIALKEY" ROUTINE which is mainly divided into two portions, one is the "CONTINUE" and the other is "ONEBYONE", both of them will be described as follows:

(1) If the key is 0-9, the program would enter into the "ONEBYONE" and its work contents are: (a) speak the keyed-in number; (b) bright the corresponding LED lamps; (c) display the keyed-in number on the 7-segment display.

(2) If the key is " = " or "*", the program would enter into the "CONTINUE" and its work contents are: (a) speak the number 1,2, . . . 9 or 9,8 . . . 2,1 sequentially, bright the corresponding LED lamps and display the corresponding number on the 7-segment display sequentially.

(3) Under any situation as above mentioned, speak "PLEASE TURN ME OFF" if there is no key-in after 120 seconds, and the program would jump into the "SING" if the "RECEIVER SWITCH" is "OFF" at this time.

IX. Fig. 12 is the appearance of the present invention, in which 30 is the telephone body, 24 is the receiver, 16 is the keyboard, 22 is the LEDs, 31 is the receiver switch with S1 and S2, 32 is the power supply switch, and D7 is the 7-segment display.

CLAIMS

1. A music and arithmetic teaching machine in the form of a telephone set comprising:

A microprocessor system in which the hardware portion mainly comprises: A CPU used for the main control of the electronic circuits, some ROMS for storing the control programs, some RAMs for storing the real-time data during operating the programs, and several I/O Ports for communicating the CPU with the outside; The software portion mainly comprises; a paragraph of control program for the number calculating, a paragraph of control program for brighting all the displays to display, a paragraph of control program for reading and executing the keyed-in codes, a paragraph of control program for generating the signals of the telephone system's dialing tone, busy tone, ring-back tone and ring tone via an I/O line or the speech synthesizer, a paragraph of control program for generating the basic musical note signals prestored in the ROM via an I/O line or the speech synthesizer, a paragraph of control program for generating a predefined song prestored in the ROM via an I/O line or the speech synthesizer. a paragraph of control program for generating the predefined phonic signals via the speech synthesizer. and a paragraph of control program for generating the speech signals of the numbers via the speech synthesizer;

A set of keyboard for communicating the operator with the CPU, which comprises: Ten key being used as the digital keys, or part of them being used as the musical notes and the remaining used for generating a predefined song; two keys being respectively used for speaking the musical note signals sequentially or counter-sequentially; four keys being used as the basic operating signs during the arithmetic operations; and two or more than two keys having other special functions;

A set of displaying device simulating the vertical or horizontal calculating format, which comprieses: A display for the operated number (such as the first addend), the operating number and the answering number; A display for expressing the basic operating signs (+ , − , × , ÷); and a display for separating the answering number from the operating number with one line for the vertical calculating format or with two lines for the horizontal calculating format;

Several displays for simulating our palms, which comprise an multisegment display for simulating the fingers and a 1-segment or multisegment display for simulating the palm center;

Several LEDs for brighting the corresponding lamps to express a random number of scale; a digital display, when generating the musical scale or numerical speech signals, to represent a corresponding number, or an multisegment display for simulating the shape of the staff's musical note to represent the corresponding spoken musical note;

A speech synthesizer being able to speak a random number, a dialingtone, a ring-tone, busy-tone, a predefined language, a random scale or a predefined song, which comprises: a speech synthesizing circuit, an amplifier for amplifing the phonic signals generated from the speech synthesizing circuit, and a speaker for converting the amplifier's phonic signals into the sound waves, and an earphone;

Several selector switches having the selecting functions;

2. The teaching machine as claimed in claim 1, wherein said software flow comprises:

(a) A paragraph of control flow for the number-calculating;

(b) A paragraph of control flow for brighting the displaying device as stated in claim 1;

(c) A paragraph of control flow for reading and executing the keyed-in codes;

(d) A paragraph of control flow for generating the signals of the dialing-tone or ring-tone or busy-tone or a predefine song via and I/O line or the speech synthesizer; and

(e) A paragraph of control flow for speaking a random number or a predefined speech via the speech synthesizer.

3. The teaching machine as claimed in claim 1, in which said toy telephone comprises:

(a) A device for brighting a digital display such as the 7-segment display to express a random musical scale;

(b) A device for expressing the musical notes via a set of multisegment display or a printing pattern for simulating the shape of the staff's musical note;

(c) A device for generating the corresponding scale signals and speaking them via the speech synthesizer or an I/O line;

(d) A device for brighting the corresponding LED lamp to express a random musical scale;

Among the above mentioned, the simultaneous operations of (a) (b) (c) (d) or (b) (c) (d) can express the concept of a musical note or staff to raise the learner's interest and effect.

4. The teaching machine as claimed in claim 1, further comprising: A device for generating the simulating dialing-tone, ring-tone, ring-back-tone and busy-tone via an I/O line or the speech synthesizer.

5. The teaching machine as claimed in claim 1, further comprising:

(a) Speech synthesizer for speaking a random number;

(b) Several digital displays for displaying the algorism; and

(c) Several analog displays for expressing the quantity by simulating the fingers and the palm center;

Among the above mentioned, the simultaneous operations of (a) (b) (c) or (a) (c) or (b) (c) can express a numerical concept and its arithmetic operation to raise the learner's interest and effect.

6. The teaching machine as claimed in claim 5, in which said speech synthesizer, digital display and analog display further comprise: A display for simulating the fingers and the palm center and which can be replaced by a display for simulating other biological or substances to express a random number with same effect.

7. Any novel feature or combination of features disclosed herein.

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